

## WHAT IS CLAIMED IS:

- 1                   1.       A human immunodeficiency virus antigenic composition  
2 comprising a human immunodeficiency virus envelope glycoprotein 160 having a  
3 gp120 subunit and a gp41 subunit wherein the carboxy-terminal end of gp120 is  
4 covalently linked through a peptide linker of at least 5 amino acids, to the amino-  
5 terminal end of gp41.
- 1                   2.       The antigenic composition of claim 1, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is truncated at a position within 5  
3 amino acids either side of amino acid 683 in SEQ ID NO:2.
- 1                   3.       The antigenic composition of claim 1, wherein the peptide linker is  
2 between 15 and 26 amino acids in length.
- 1                   4.       The antigenic composition of claim 1, wherein the peptide linker is  
2 selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ  
3 ID NO:13, SEQ ID NO:14.
- 1                   5.       The antigenic composition of claim 1, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 has at least 70% amino acid sequence  
3 identity to sequence SEQ ID NO:2.
- 1                   6.       The antigenic composition of claim 1, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is SEQ ID NO:7.
- 1                   7.       The antigenic composition of claim 2, wherein the human  
2 immunodeficiency virus envelope glycoprotein has at least 70% amino acid sequence identity  
3 to sequence SEQ ID NO:4.
- 1                   8.       The antigenic composition of claim 2, wherein the human  
2 immunodeficiency virus envelope glycoprotein is SEQ ID NO:8.
- 1                   9.       The antigenic composition of claim 1, wherein the gp120 subunit and  
2 the gp41 subunit are from different human immunodeficiency virus strains.
- 1                   10.      The antigenic composition of claim 1, wherein the gp120 subunit and  
2 the gp41 subunit are from the same human immunodeficiency virus strain.

1                   11.    A method of manufacturing a human immunodeficiency virus  
2 antigenic composition comprising a human immunodeficiency virus envelope glycoprotein  
3 160 having a gp120 subunit and a gp41 subunit wherein the carboxy-terminal subunit of  
4 gp120 is covalently linked through a peptide linker of at least 5 amino acids to the amino  
5 terminal end of gp41, the method comprising:

6                               (i) obtaining a nucleic acid encoding a gp 120 and a gp 41.

7                               (ii) introducing in frame between the gp120 and the gp41

8 coding segments a nucleic acid that encodes a peptide linker of between 6 and 29  
9 amino acids, to yield a gene encoding a human immunodeficiency virus antigenic  
10 composition;

11                              (iii) operably linking the gene to a expression cassette;

12                              (iv) incorporating the expression cassette into a mammalian  
13 host cell;

14                              (v) permitting the host to express the human  
15 immunodeficiency virus antigenic composition; and

16                              (vi) isolating the composition from the host cell.

1                   12.    The method of claim 11, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is truncated at a position  
3 within 5 amino acids either side of amino acid 683 in SEQ ID NO:2.

1                   13.    The method of claim 11, wherein the peptide linker is between 15 and  
2 26 amino acids in length.

1                   14.    The method of claim 11, wherein the peptide linker is selected from  
2 the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13,  
3 SEQ ID NO:14.

1                   15.    The method of claim 11, wherein the human immunodeficiency virus  
2 envelope glycoprotein 160 has at least 70% amino acid sequence identity to sequence SEQ  
3 ID NO:2.

1                   16.    The antigenic composition of claim 1, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is SEQ ID NO:7.

1                   17.     The method of claim 12, wherein the human immunodeficiency virus  
2 envelope glycoprotein has at least 70% amino acid sequence identity to sequence SEQ ID  
3 NO:4.

1                   18.     The method of claim 12, wherein the human immunodeficiency virus  
2 envelope glycoprotein is SEQ ID NO:8.

1                   19.     The method of claim 11, wherein the gp120 subunit and the gp41  
2 subunit are from different human immunodeficiency virus strains.

1                   20.     The method of claim 11, wherein the gp120 subunit and the gp41  
2 subunit are from the same human immunodeficiency virus strain.

1                   21.     A vaccine for protecting a human from human immunodeficiency virus  
2 infection comprising:

3                               (i) an aliquot amount of a human immunodeficiency  
4 virus antigenic composition comprising a human immunodeficiency virus  
5 envelope glycoprotein 160 having a gp120 subunit and a gp41 subunit wherein  
6 the carboxy-terminal end of gp120 is covalently linked through a peptide linker  
7 of at least 5 amino acids to the amino-terminal end of gp41; and

8                               (ii) a sterile pharmaceutically acceptable carrier.

1                   22.     The vaccine of claim 21, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is truncated at a position  
3 within 5 amino acids either side of amino acid 683 in SEQ ID NO:2.

1                   23.     The vaccine of claim 21, wherein the peptide linker is between 15 and  
2 26 amino acids in length.

1                   24.     The vaccine of claim 21, wherein the peptide linker is c selected from  
2 the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13,  
3 SEQ ID NO:14.

1                   25.     The vaccine of claim 21, wherein the human immunodeficiency virus  
2 envelope glycoprotein 160 has at least 70% amino acid sequence identity to sequence SEQ  
3 ID NO:2.

1                   26.     The vaccine of claim 21, wherein the human immunodeficiency virus  
2 envelope glycoprotein 160 is SEQ ID NO:7.

1                   27.     The vaccine of claim 22, wherein the human immunodeficiency virus  
2 envelope glycoprotein 160 has at least 70% amino acid sequence identity to sequence SEQ  
3 ID NO:4.

1                   28.     The vaccine of claim 22, wherein the human immunodeficiency virus  
2 envelope glycoprotein is SEQ ID NO:8.

1                   29.     The vaccine of claim 21, wherein the gp120 subunit and the gp41  
2 subunit are from different human immunodeficiency virus strains.

1                   30.     The vaccine of claim 21, wherein the gp120 subunit and the gp41  
2 subunit are from the same human immunodeficiency virus strain.

1                   31.     The vaccine of claim 21, wherein the aliquot amount of human  
2 immunodeficiency virus antigenic composition is between 0.5 and 1 milligrams antigenic  
3 composition per milliliter of sterile pharmaceutically acceptable carrier.

1                   32.     The vaccine of claim 21, wherein the aliquot amount of human  
2 immunodeficiency virus antigenic composition is in a lyophilized state.

1                   33.     A method of protecting a human from human immunodeficiency virus  
2 infection comprising:

3                   administering to a human an amount of a human  
4 immunodeficiency virus antigenic composition comprising a human  
5 immunodeficiency virus envelope glycoprotein 160 having a gp120 subunit and a  
6 gp41 subunit, wherein the carboxy-terminal end of gp120 is covalently linked  
7 through a peptide linker of at least 5 amino acids to the amino-terminal end of  
8 gp41, wherein the amount administered is effective to immunize the human  
9 against human immunodeficiency virus infection.

1                   34.     The method of claim 33, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is truncated at a position  
3 within 5 amino acids either side of amino acid 683 in SEQ ID NO:2.

1           35.     The method of claim 33, wherein the peptide linker is between  
2     15 and 26 amino acids in length.

1           36.     The method of claim 33, wherein the peptide linker is selected from  
2     the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13,  
3     SEQ ID NO:14.

4           37.     The method of claim 33, wherein the human immunodeficiency virus  
5     envelope glycoprotein 160 has at least 70% amino acid sequence identity to sequence SEQ  
6     ID NO:2.

1           38.     The method of claim 33, wherein the human immunodeficiency virus  
2     envelope glycoprotein 160 is SEQ ID NO:7.

1           39.     The method of claim 34, wherein the human immunodeficiency virus  
2     envelope glycoprotein has at least 70% amino acid sequence identity to sequence SEQ ID  
3     NO:4.

1           40.     The method of claim 34, wherein the human immunodeficiency virus  
2     envelope glycoprotein is SEQ ID NO:8.

1           41.     The method of claim 33, wherein the gp120 subunit and the gp41  
2     subunit are from different human immunodeficiency virus strains.

1           42.     The method of claim 33, wherein the gp120 subunit and the gp41  
2     subunit are from the same human immunodeficiency virus strain.

1           43.     The method of claim 33, wherein the amount administered effective to  
2     immunize the human against human immunodeficiency virus infection is between 1 $\mu$ g/kg and  
3     20 $\mu$ g/kg per dose per inoculation.

1           44.     The method of claim 33, wherein the human immunodeficiency virus  
2     antigenic composition further comprises one or more glycoprotein 160 ligands chosen from  
3     the group consisting of CD4, CCR5 and CXCR4.

1           45.     The method of claim 44, wherein the molar ration of glycoprotein 160  
2     to ligand is between 3:1 and 1:3 for each ligand species of the composition.

1           46.    An nucleic acid comprising a coding sequence for a human  
2 immunodeficiency virus envelope glycoprotein 160 having a gp120 subunit and a gp41  
3 subunit wherein the carboxy-terminal end of gp120 is covalently linked through a peptide  
4 linker of at least 5 amino acids to the amino-terminal end of gp41.

1           47.    A live recombinant vaccine comprising an nucleic acid comprising a  
2 coding sequence for a human immunodeficiency virus envelope glycoprotein 160 having a  
3 gp120 subunit and a gp41 subunit wherein the carboxy-terminal end of gp120 is covalently  
4 linked through a peptide linker of at least 5 amino acids to the amino-terminal end of gp41.

1           48.    The nucleic acid of claim 46, further comprising regulatory sequences  
2 for the expression of DNA in eukaryotic cells operably linked to the human  
3 immunodeficiency virus envelope glycoprotein 160 sequence.

1           49.    The live recombinant vaccine of claim 47, further comprising  
2 regulatory sequences for the expression of DNA in eukaryotic cells operably linked to the  
3 human immunodeficiency virus envelope glycoprotein 160 sequence.

1           50.    The antigenic composition of claim 1, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 comprises the extracellular subunits of  
3 envelope glycoprotein 160.

1           51.    The vaccine of claim 21, wherein the human immunodeficiency virus  
2 envelope glycoprotein 160 comprises the extracellular subunits of envelope glycoprotein 160.

1           52.    The method of claim 33, wherein the human immunodeficiency virus  
2 envelope glycoprotein 160 comprises the extracellular subunits of envelope glycoprotein 160.

1           53.    The nucleic acid of claim 46, wherein the human immunodeficiency  
2 virus envelope glycoprotein 160 comprises the extracellular subunits of envelope  
3 glycoprotein 160.

1           54.    The live recombinant vaccine of claim 47, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 comprises the extracellular subunits of  
3 envelope glycoprotein 160.

1                    55.    The human immunodeficiency virus antigenic composition of claim 1,  
2 wherein the peptide linker is of 6 to 29 amino acids.

1                    56.    The method of claim 11, wherein the peptide linker is of 6 to 29 amino  
2 acids.

1                    57.    The method of claim 33, wherein the peptide linker is of 6 to 29 amino  
2 acids.

1                    58.    The nucleic acid of claim 46, wherein the peptide linker is of 6 to 29  
2 amino acids.

1                    59.    The live recombinant vaccine of claim 47, wherein the peptide linker is  
2 of 6 to 29 amino acids.

1                    60.    The nucleic acid of claim 46, wherein the human immunodeficiency  
2 virus envelope glycoprotein 160 sequence is SEQ ID NO:7 or SEQ ID NO:8.

1                    61.    The live recombinant vaccine of claim 47, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 sequence is SEQ ID NO:7 or SEQ ID  
3 NO:8.

1                    62.    The nucleic acid of claim 46, further comprising a nucleic acid  
2 encoding one or more glycoprotein 160 ligands chosen from the group consisting of CD4,  
3 CCR5 and CXCR4.

1                    63.    The live recombinant vaccine of claim 47, further comprising one or  
2 more glycoprotein 160 ligands chosen from the group consisting of CD4, CCR5 and CXCR4.

1                    64.    The vaccine of claim 21, further comprising (iii) one or more  
2 glycoprotein 160 ligands chosen from the group consisting of CD4, CCR5 and CXCR4.

1                    65.    The method of claim 33, wherein the antigenic composition further  
2 comprises one or more glycoprotein 160 ligands chosen from the group consisting of CD4,  
3 CCR5 and CXCR4.

1                    66.    The method of claim 11, wherein the gp41 subunit is an extracellular  
2 subunit(s) of gp41.

1                   67.     The nucleic acid of claim 46, wherein the peptide linker is between 15  
2     and 26 amino acids in length.

1                   68.     The nucleic acid of claim 46, wherein the peptide linker is selected  
2     from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID  
3     NO:13, SEQ ID NO:14.

1                   69.     The nucleic acid of claim 46, wherein the human immunodeficiency  
2     virus envelope glycoprotein 160 has at least 70% amino acid sequence identity to sequence  
3     SEQ ID NO:2.

1                   70.     The nucleic acid of claim 46, wherein the human immunodeficiency  
2     virus envelope glycoprotein 160 is SEQ ID NO:7.

1                   71.     The nucleic acid of claim 46, wherein the human  
2     immunodeficiency virus envelope glycoprotein has at least 70% amino acid sequence  
3     identity to sequence SEQ ID NO:4.

1                   72.     The nucleic acid of claim 46, wherein the human immunodeficiency  
2     virus envelope glycoprotein is SEQ ID NO:8.

1                   73.     The nucleic acid of claim 46, wherein the gp120 subunit and the gp41  
2     subunit are from different human immunodeficiency virus strains.

1                   74.     The nucleic acid of claim 46, wherein the gp120 subunit and the gp41  
2     subunit are from the same human immunodeficiency virus strain.

1                   75.     The live recombinant vaccine of claim 47, wherein the peptide linker is  
2     between 15 and 26 amino acids in length.

1                   76.     The live recombinant vaccine of claim 47, wherein the gp120 subunit  
2     and the gp41 subunit are from the same human immunodeficiency virus strain.

1                   77.     The live recombinant vaccine of claim 47, wherein the peptide linker is  
2     selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ  
3     ID NO:13, SEQ ID NO:14.



1           78.     The live recombinant vaccine of claim 47, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 has at least 70% amino acid sequence  
3 identity to sequence SEQ ID NO:2.

1           79.     The live recombinant vaccine of claim 47, wherein the human  
2 immunodeficiency virus envelope glycoprotein 160 is SEQ ID NO:7.

1           80.     The live recombinant vaccine of claim 47, wherein the human  
2 immunodeficiency virus envelope glycoprotein has at least 70% amino acid sequence identity  
3 to sequence SEQ ID NO:4.

1           81.     The live recombinant vaccine of claim 47, wherein the human  
2 immunodeficiency virus envelope glycoprotein is SEQ ID NO:8.

1           82.     The live recombinant vaccine of claim 47, wherein the gp120 subunit  
2 and the gp41 subunit are from different human immunodeficiency virus strains.

1           83.     The nucleic acid of claim 62, wherein the molar ration of glycoprotein  
2 160 to ligand is between 3:1 and 1:3 for each ligand species of the composition.

1           84.     The live recombinant vaccine of claim 63, wherein the molar ration of  
2 glycoprotein 160 to ligand is between 3:1 and 1:3 for each ligand species of the composition.